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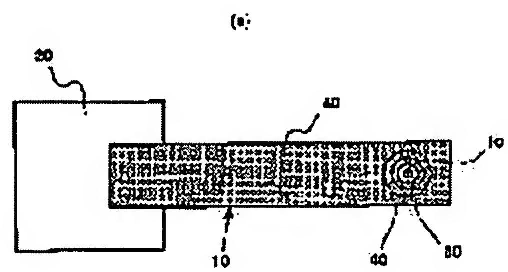
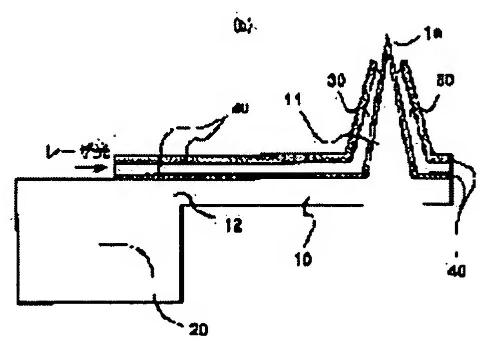
(54) SCANNING PROBE AND ITS MANUFACTURE





(57)Abstract:
PROBLEM TO BE SOLVED: To provide a probe in which the uniformity of a very small opening part for the optical measurement of a near field to be formed is good and whose resolution is high even when it is used for observation under an atomic force microscope and to provide its manufacturing method.
SOLUTION: A probe is used for a scanning probe microscope. The probe is provided with a flexible cantilever part 10 which comprises a free end part and a fixed end part 12 and with a probe part 11 which is formed in the free end part and which is erected and installed on one main face of the cantilever part 10. An optical waveguide part which inputs and outputs light near the tip of the probe part 11 is formed of an optical transmission layer 30 one face and the other face of which are covered with metal films 40

which have a light reflecting characteristic. The uniformity of an outside exposure opening part in the optical transmission payer 30 which is formed according to the shape of the probe part 11 is enhanced, and the operation of the cantilever part 10 is not sacrificed in an atomic force microscope or the like.

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CLAIMS

[Claim(s)]
[Claim 1] The probe characterized by to be formed the optical waveguide which outputted and inputs light [near the tip of said probe section] by the optical transmission layer with which it reached on the other hand by the metal membrane which is the probe used for a scanning probe microscope, has the flexible cantilever section which has a free edge and the fixed-end section, and the probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, and has a light-reflex property, and the interface of another side was covered.
[Claim 2] The flexible cantilever section which is the probe used for a scanning probe microscope, and has a free edge and the fixed-end section, The probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, The optical transmission layer which extends along with one principal plane of said flexible cantilever section, and said probe section, The probe characterized by having the metal membrane which has ejection and the light reflex property which said optical transmission layer reaches on the other hand, and covers the interface of another side, carrying out external exposure of said optical transmission layer [near the tip of said probe section].
[Claim 3] It is the probe characterized by to be the probe used for a scanning probe microscope, to have the flexible cantilever section which has a free edge and the fixed-end section, the probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, and the metal membrane which has the light-reflex property which covers said flexible cantilever section and said probe section except for the apical surface of said probe section, and for both said flexible cantilever and said probe section to have an optical transmission property.
[Claim 4] The flexible cantilever section which is the probe used for a scanning probe microscope, and has a free edge and the fixed-end section, The probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, The 1st metal membrane which has the light reflex property which covers said probe section, and the optical transmission layer by which the laminating was carried out to said 1st metal membrane, The 2nd metal membrane which has the light reflex property which covers said optical transmission layer and said flexible cantilever section, carrying out external exposure of said optical transmission layer [near the tip of said probe section], It is the probe characterized by enabling measurement of the surface potential of a sample by ****(ing), and said flexible cantilever section's having an optical transmission property, and covering the 1st metal membrane in the probe section.
[Claim 5] The manufacture approach of the scanning probe characterized by to have the optical waveguide formation process which forms the optical transmission layer which bears the probe formation process which is the manufacture approach of the probe used for a scanning probe microscope, and forms the probe which was radicalized in the cantilever section, and the optical waveguide which it reaches on the other hand by the metal membrane which has a light-reflex property according to said probe configuration, and the interface of another side is covered, and outputs and inputs light [near the tip of said probe section].

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the probe used for a scanning probe microscope, and its manufacture approach.
[0002]
[Description of the Prior Art] The conventional example of the probe used for the approaching space optical measurement made in SNOAM (Scanning Nearfield Optical Atomic Force Microscope), i.e., a scanning myopia field atomic force microscope, is shown in drawing 11 .
[0003] In drawing 11 , this kind of probe 101 is produced with the optical fiber for optical transmissions. After heating an optical fiber according to the so-called heating hauling method, extending thinly in the shape of a taper in more detail, extracting to small aperture and being radicalized needlelike, the point which cuts and bears the minute opening 102 is formed. And a probe 101 is produced after a vent process by carrying out the coat of the aluminum to the thickness of about 100nm with inclination rotation vacuum deposition further at the periphery section of optical whole FAIBA except the tip.
[0004] that of the optical fiber with which radicalization is not given is also obtained in this probe 101, laser light is introduced into it from end side 103, and light is made to be outputted to it from the minute opening 102 of the end of the probe to a sample front face. The approaching space optical measurement containing the illumination mode (Genichi Otsu: application physics, the 65th volume, No. 1 (1996) pp.2 -12 reference) in which this condenses the scattered light produced from the sample front face with the objective lens placed near the sample, and a SNOAM image (NSOM image) is obtained is attained.
[0005] On the other hand, this probe 101 can be used also for the observation as AFM (Atomic Force Microscope), i.e., an atomic force microscope. In AFM, it is possible by detecting the variation rate of lever section 10L produced by the interaction of a sample and a probe with the optical-lever method using laser light. In this case, he forms a mirror side in the laser radiation field 111 of lever section 10L by carrying out metal covering, and is trying to raise reflection of the laser light concerned for this displacement detection.
[0006]
[Problem(s) to be Solved by the Invention] In such a conventional probe, it has realized by heating an optical fiber, although the minute opening 102 of the end of the probe is formed, and extracting to small aperture. For this reason, there is a problem that the repeatability of the minute opening 102, i.e., the homogeneity about the size or the engine performance of minute opening formed in each probe, is not good.
[0007] moreover -- since it is covered with the clad of an optical fiber etc. except place [where the end of the probe is radicalized] -- thick -- not becoming -- it does not obtain but there is also a problem that high resolution is not obtained, in the atomic force microscope observation performed based on the actual variation rate of the probe concerned.
[0008] Therefore, the homogeneity of minute opening formed is good, and the place which this invention is made in view of the point mentioned above, and is made into the main purpose is to offer

the probe and its manufacture approach of the scanning probe microscope which can obtain high resolving power, also when it moreover uses for atomic force microscope observation etc.
[0009]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention concerning claim 1 The flexible cantilever section which is the probe used for a scanning probe microscope, and has a free edge and the fixed-end section, The probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, It is characterized by forming the optical waveguide which outputs and inputs light [near the tip of said probe section] by the optical transmission layer with which it ****(ed), and reached on the other hand by the metal membrane which has a light reflex property, and the interface of another side was covered.
[0010] According to invention of this claim 1, the optical transmission layer with which it reached on the other hand by the metal membrane which has a light reflex property, and the interface of another side was covered leads the introduced light to a probe section point efficiently as optical waveguide, and the I/O of light of it is attained [near the probe section tip].
[0011] The flexible cantilever section which invention concerning claim 2 is a probe used for a scanning probe microscope, and has a free edge and the fixed-end section, The probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, It is characterized by having the optical transmission layer which extends along with one principal plane of said flexible cantilever section, and said probe section, and the metal membrane which has the light reflex property which said optical transmission layer reaches on the other hand, and covers the interface of another side, carrying out external exposure of said optical transmission layer [near the tip of said probe section].
[0012] According to invention of this claim 2, the optical transmission layer which extends along with one principal plane of the cantilever section and the probe section Since it reaches on the other hand, the interface of another side is covered with the metal membrane which has a light reflex property and external exposure of the optical transmission layer is moreover carried out [near the tip of the probe section] By the optical waveguide formed in the form by which the laminating was carried out to the probe section side, an introductory light is efficiently led to a probe section point, and I/O of light is attained [near the probe section tip].
[0013] The flexible cantilever section which invention concerning claim 3 is a probe used for a scanning probe microscope, and has a free edge and the fixed-end section, The probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, It has the metal membrane which has the light reflex property which covers said flexible cantilever section and said probe section except for the apical surface of said probe section, and both said flexible cantilever and said probe section are characterized by having an optical transmission property.
[0014] According to invention of this claim 3, the optical waveguide formed of the metal membrane which has the light reflex property which covers the cantilever section and the probe section except for the apical surface of the probe section, and the cantilever and the probe section which have an optical transmission property, respectively leads an introductory light to a probe section point efficiently through the cantilever section concerned and the probe section, and enables I/O of light [near the probe section tip].
[0015] The flexible cantilever section which invention concerning claim 4 is a probe used for a scanning probe microscope, and has a free edge and the fixed-end section, The probe section which was formed in said free edge and set up by one principal plane of said flexible cantilever section, The 1st metal membrane which has the light reflex property which covers said probe section, and the optical transmission layer by which the laminating was carried out to said 1st metal membrane, It has the 2nd metal membrane which has the light reflex property which covers said optical transmission layer and said flexible cantilever section, carrying out external exposure of said optical transmission layer [near the tip of said probe section], and said flexible cantilever section is characterized by having an optical transmission property.
[0016] The 1st metal membrane which has the light reflex property which covers the probe section according to invention of this claim 4, The optical transmission layer by which the laminating was

carried out to the 1st metal membrane, and the 2nd metal membrane which has the light reflex property which covers an optical transmission layer and the cantilever section, carrying out external exposure of the optical transmission layer [near the tip of the probe section], Since optical waveguide is formed of the cantilever section which has an optical transmission property, an introductory light is efficiently led to a probe section point through the cantilever section, and I/O of light is enabled [near the probe section tip].
[0017] Invention concerning claim 5 be characterize by to have the optical waveguide formation process which form the optical transmission layer which bear the probe formation process which be the manufacture approach of the probe use for a scanning probe microscope , and form the probe which be radicalized in the cantilever section , and the optical waveguide which it reach on the other hand by the metal membrane which have a light reflex property according to said probe configuration , and the interface of another side be cover , and output and input light [near the tip of said probe section] .
[0018] According to invention of this claim 5, the above-mentioned optical waveguide which draws light near the probe section applies a semi-conductor manufacture process in accordance with the radicalized probe configuration, and may be formed.
[0019]
[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained to a detail based on a drawing.
[0020]
[The gestalt 1 of operation] Drawing 1 shows the outline structure of the probe used for the scanning probe microscope by the gestalt of 1 implementation of this invention, (a) is that top view and (b) is that longitudinal sectional view.
[0021] This probe is formed in the cantilever-type cantilever mold used under the atomic force microscope, the scanning Maxwell stress microscope, etc. in drawing 1 . In more detail, the cantilever section 10 which bears the principal piece of a probe is flexibility, and while it is formed in the shape of straight side of Si (silicon) and fixed support of the end is carried out at susceptor 20, the other end is the free end.
[0022] The shape of acute and the needlelike probe 11 called a tip is fabricated by one here [concerned / the cantilever section and here] at the other end side of the cantilever section 10. a probe 11 -- the abbreviation for the cantilever section 10 -- a variation rate -- it is set up by the direction.
[0023] The optical transmission layer 30 which bears optical waveguide is Si Ox2, for example, SiO. It is formed and extends along the front face of not only the near field where one principal plane 11 of the cantilever section 10, i.e., a probe, is allotted but the probe 11. However, on the other hand, it reaches, the interface of another side is covered, and this optical transmission layer 30 is covered in more detail with that form that the optical transmission layer 30 exposes outside [near the tip of a probe 11] by the metal thin film 40 with the metal thin film 40. Thereby, while opening of the tip part 1e of a probe 11 is carried out, the optical transmission layer 30 serves as structure which extends also from an upper layer side to near the tip of a probe 11 in the form put with the metal thin film 40 also from the lower layer side so that it may understand from the longitudinal sectional view of drawing 1 (b).
[0024] The metal thin film which is for raising the guided wave nature of the light in the optical transmission layer 30, for example, has the light reflex (niobium) property of aluminum (aluminum), Nb, etc. is suitable for the metal thin film 40.
[0025] Thus, the optical transmission layer 30 covered with the metal thin film 40 will form the optical waveguide which draws the laser light for approaching space optical measurement near the point of a probe 11 with a well head from the edge by the side of the lever fixed part 12.
[0026] According to the probe of the above configurations, the laser light introduced into the optical transmission layer 30 While becoming possible to output to a sample side near the tip of a probe 11 through the inside of the optical transmission layer 30 and attaining approaching space optical measurement To an atomic force microscope pan, the optical-lever method by the suitable cantilever-type cantilever mold probe for a scanning Maxwell stress microscope etc. is detectable using having covered the 1st metal membrane near the probe section tip indicated by the 4th term of a claim.

[0027]
[The gestalt 2 of operation] Drawing 2 shows the outline structure of the probe used for the scanning probe microscope by the gestalt of other operations of this invention, (a) is the top view and (b) is the longitudinal sectional view.
[0028] This probe is formed in the cantilever-type cantilever mold used under the atomic force microscope, the scanning Maxwell stress microscope, etc. in drawing 2 . In more detail, the cantilever section 10 is formed of Si O2 (silicon oxide) which has flexibility and an optical transmission property, and while fixed support of the end is carried out at susceptor 20, the other end is the free end.
[0029] The shape of acute and the needlelike probe 11 called a tip is a cantilever body and really [concerned] fabricated at the other end side of the cantilever section 10. Therefore, the probe 11 also has the same optical transmission property as the cantilever section 10.
[0030] The cantilever section 10 covers the whole except for apical surface 1e of a probe 11, and is covered with the metal thin film 40. Therefore, only apical surface 1e of a probe 11 will be exposed outside as minute opening. This metal thin film 40 is for raising the guided wave nature of the light in the cantilever section 10 and a probe 11, and the metal thin film which has the light reflex (niobium) property of aluminum (aluminum), Nb, etc. is applied like drawing 1 .
[0031] Thus, the cantilever section 10 and the probe 11 which were covered with the metal thin film 40 will form the optical waveguide which leads laser light to the point of a probe 11 efficiently from the lever fixed part 12 side.
[0032] According to the probe of the above configurations, the laser light introduced into the cantilever section 10 can detect the optical-lever method by the suitable cantilever-type cantilever mold probe for an atomic force microscope, a scanning Maxwell stress microscope, etc. while becoming possible to output to a sample side from the tip of a probe 11 through the inside of the cantilever section 10 and attaining approaching space optical measurement.
[0033]
[The gestalt 3 of operation] The gestalt 1 of operation shown in drawing 1 can also be changed in the gestalt of operation as shown in drawing 3 . Also in this drawing 3 , (a) is the top view of a probe and (b) is that longitudinal sectional view. Moreover, the same sign is given to the part equivalent to drawing 1 .
[0034] namely, the optical waveguide which consists of a metal thin film 40 which covers the optical transmission layer 30 and this as this alteration mode -- the cantilever section 10 top -- setting -- the width of face of the cantilever section 10 -- smallness -- it can form in width of face. Thereby, the load rate of the cantilever section 10 can be stopped and it becomes easy to demonstrate still higher resolution in an atomic force microscope, a scanning Maxwell stress microscope, etc.
[0035] Moreover, to the metal thin film 40 breaking off in the part of the free one end side of the cantilever section 10 in drawing 1 , and the optical transmission layer 30 being exposed in the part concerned, in drawing 3 , the metal thin film 40 is formed so that the optical transmission layer 30 may be closed completely in this part. By taking such structure, the optical leakage of optical waveguide will be prevented and the guided wave of a more efficient light will be attained.
[0036]
[The gestalt 4 of operation] Drawing 4 shows the outline structure of the probe of the scanning probe microscope according to the gestalt of other operations further of this invention. In addition, (a) is rear view although this drawing (b) of the point which is the longitudinal sectional view is the same as that of the former.
[0037] In drawing 4 , although form in the cantilever-type cantilever mold for which this probe be also use under the atomic force microscope, the scanning Maxwell stress microscope, etc., while the cantilever section 10 be form of Si O2 (silicon oxide) which have an optical transmission property, the laminating of the tooth back optical transmission layer 31 which have the optical transmission property similarly formed with silicon oxide so that installation of laser light might be enabled from a field opposite to the support side of a probe 11 be carry out.
[0038] The probe 11 set up at the free edge side of the cantilever section 10 is formed of Si (silicon), and

the outside surface is covered with the 1st metal thin film 41.
[0039] The laminating of the optical transmission layer 32 formed of Si O2 (silicon oxide) which has an optical transmission property is carried out to the 1st metal thin film 41. this optical transmission layer 32 -- the front face of a probe 11 -- also meeting -- it extends in the form where the apical surface of a probe 11 is exposed.
[0040] The cantilever section 10 is covered with the 2nd metal thin film 42 by this optical transmission layer 31 and 32 lists. However, the 2nd metal thin film 42 is formed in the form in which the tooth-back optical transmission layer 31 is exposed in part. This outcrop is allotted to the bond part approach of the cantilever section 10 and susceptor 20, and can introduce laser light from here.
[0041] The metal thin film which is for raising the guided wave nature of the light in the cantilever section 10 to the optical transmission layer 31 and 32 lists, for example, has the light reflex (niobium) property of aluminum (aluminum), Nb, etc. is suitable for the 1st and 2nd metal thin films 41 and 42.
[0042] Thus, the cantilever section 10 will form the optical waveguide which draws laser light near the point of a probe 11 with a well head from the exposure of the tooth-back optical transmission layer 31 in the optical transmission layer 31 and 32 lists which were covered with the metal thin films 41 and 42.
[0043] According to the probe of the above configurations, the light introduced into the tooth-back optical transmission layer 31 can detect the optical-lever method by the suitable cantilever-type cantilever mold probe for an atomic force microscope, a scanning Maxwell stress microscope, etc. while becoming possible to output to a sample side near the tip of a probe 11 through the cantilever section 10 and the optical transmission layer 32 and attaining approaching space optical measurement.
[0044] The perspective view of the probe shown in drawing 4 is shown in drawing 5 . Here, the laser light for realizing detection by the optical-lever method in an atomic force microscope, a scanning Maxwell stress microscope, etc. indicates signs that this probe irradiates from an opposite field side to be the support side of a probe 11.
[0045] This laser light is irradiated by the location which faces the probe 11 on the metal thin film 42. The laser light exposure field of the metal thin film 42 has an area larger than other fields, and he is trying to lead it to the photo detector which does not illustrate laser light certainly by this exposure field.

[0046] Each probe of structure explained above is not necessarily limited to using one for one susceptor, preparing in it: Drawing 6 showed the mode which forms two or more probes in one susceptor.
[0047] According to this, two or more kinds of probes mentioned above can also be formed in one susceptor, and two or more probes of the same class can also be formed in one susceptor.
[0048] Next, the manufacture approach of the probe mentioned above is explained.
[0049] Drawing 7 thru/or drawing 10 show the main sectional views of the probe concerned to show the mode of the production processes with the main probe by the gestalt 1 of the above-mentioned implementation. In addition, the production process about the optical waveguide formed in below at these at the cantilever section and a probe list is extracted and explained, and it is omitting about the manufacture mode of the susceptors and others other than these each part.
[0050] As first shown in drawing 7 (a), silicon oxide (Si O2) 1M of predetermined thickness are formed by oxidizing thermally the front face of a silicon substrate 1. These silicon oxide 1M become an etching mask at the time of forming a probe behind.
[0051] And as are shown in drawing 7 (b), and photoresist 1R is applied on silicon oxide 1M and it is further shown in drawing 7 (c), circular patterning is performed using a photolithography technique to this photoresist 1R, and it is the resist mask one R0. It forms.
[0052] Then, as shown in drawing 7 (d), it is the above-mentioned resist mask one R0. By using and etching silicon oxide 1M, it is the resist mask one R0. Mask (Si O2) 1M0 by which the pattern was imprinted It is formed.
[0053] Mask (Si O2) 1M0 After formation is mask 1M0, as shown in drawing 8 R> 8 (e). Upper resist mask one R0 As it removes and is shown in drawing 8 (f), it is mask 1M0. The silicon projection 110 of the cone form before acute oxidation is formed using the isotropic dry etching according the formed silicon substrate 1 to reactive ion etching (RIE:Reactive Ion Etching).

[0054] the reactant gas used for etching here -- a reaction -- quick -- advancing -- mask 1M0 [and] it is -- in order to enlarge the selection ratio of etching with silicon oxide, generally the gas of a fluorine (F) system is used. as typical gas -- SF6 it is . in addition -- if it is gas containing a fluorine (F) -- SF6 Not the thing limited but CF4 CHF3 etc. -- gas may be used.
[0055] Moreover, it is O2 in order to acquire the configuration after etching (the so-called profile) in the configuration of arbitration. It is also effective to add gas and the gas containing C. Here, although the silicon projection 110 was formed using dry etching, forming using wet etching is also possible.
[0056] After etching for this projection formation is completed, as it is shown in drawing 8 (g), it is mask 1M0. Acute oxidation is performed to the silicon projection 110 of a condition [having attached]. This acute oxidation obtains 1000-degree Centigrade wet thermal oxidation, and a line obtains silicon oxide (Si O2) 1X with a thickness of about 1.2 micrometers for 6.5 hours. In that case, when the silicon projection 110 receives the compressive stress by the oxide film of the perimeter, a tip is radicalized.
[0057] After radicalization processing of such silicon projection 110 is completed, as shown in drawing 8 (h), a buffer fluoric acid solution (BHF) is used, and it is mask 1M0. And silicon oxide 1X is removed. While the probe (chip) 11 in which the tip was radicalized is obtained in this way, the cantilever section 10 united with this probe 11 by the silicon substrate 1 will be formed. In addition, each process of the above (a) thru/or (h) bears a probe formation process.
[0058] After formation of a probe 11 vapor-deposits the metal thin film 401 to the principal plane of the cantilever section 10 in which the probe 11 was formed, as shown in drawing 9 (i). About 50nm of metal thin films which make a principal component aluminum (aluminum), Nb (niobium), Pt (platinum), Ti (titanium) and W (tungsten), or these is formed more in detail as sufficient thickness by which light is not absorbed by the lower layer cantilever section 10.
[0059] And as shown in drawing 9 (j), the above-mentioned optical transmission layer 30 is formed on this metal thin film 401. The optical transmission layer 30 is Si Ox2, for example, Si O. By thickness 2 micrometers or less, membranes can be formed by vacuum evaporationo and it can form.
[0060] As furthermore shown in drawing 9 (k), the metal thin film 402 is formed on the optical transmission layer 30. Here, Nb or (niobium) W is formed by vacuum evaporationo, a spatter, etc. Moreover, the thickness of the metal thin film 402 has obtained the result good as a probe by being referred to as 0.2 micrometers.
[0061] Drawing 9 (i) After the foundation of optical waveguide is made by - (k), it moves to processing (etchback) of detailed processing in the point of a probe 11. As shown in drawing 9 (l) the start of this micro-processing processing, resist 4R is applied to metal thin film 402 front face.
[0062] Subsequently, it etches until covering **** 402' which projected by probe 11 tip exposes this applied resist 4R by the oxygen (O2) plasma, as shown in drawing 10 (m). Resist 4R' which became thin is used by this as an etching mask of the metal thin film 402 in the process shown in following drawing 10 (n).
[0063] namely, -- drawing 10 -- (-- n --) -- a process -- **** -- the above -- covering -- **** -- 402 -- ' -- for example, -- SF -- six -- the plasma -- removing -- a probe -- 11 -- a tip -- projecting -- having had -- optical transmission -- **** -- 30 -- ' -- exposing -- making . The condition like drawing 10 (o) is acquired by exfoliating resist 4R' from the metal thin film 402 after that. This condition is equivalent to the condition that the metal thin film 402 carried out opening in the height perimeter of a probe 11.
[0064] Optical transmission **** 30' is removed by the buffer fluoric acid solution (BHF), projection end-face 1e by the probe 11 is exposed, and after exfoliation of resist R' serves as a gestalt as shown in drawing 10 (p). In this gestalt, the metal thin films 401 and 402 will bear the metal thin film 40 of the probe shown in previous drawing 1 . In addition, each process of the above (i) thru/or (p) bears an optical waveguide formation process.
[0065] In this way, since the optical waveguide which leads light to about 11 probe applies a semi-conductor manufacture process along with the radicalized probe 11 and it may be formed, the homogeneous problem of minute opening of optical waveguide [as / in the conventional example] will be solved, and formation of positive minute opening moreover uniformly defined with the acute configuration of a probe 11 will be made.

[0066] Moreover, since the cantilever structure where the same atomic force microscope observation as usual can be performed is maintained, resolution in the observation concerned is not sacrificed.
[0067] Furthermore, since it provides to a module with the two same probe scanning points of the probe for atomic force microscope observation or scanning Maxwell stress microscope observation, and minute opening for approaching space optical measurement and they are realized in the almost same location, it becomes possible to use these scanning points for coincidence separately, and to perform observation and measurement.
[0068] In addition, although the manufacture approach was explained only about the probe by the gestalt 1 of operation shown above at drawing 1 The point which applies a semi-conductor manufacture process along with the probe 11 in which the optical waveguide which leads light to about 11 probe was radicalized, and may be formed from the first The point of maintaining the cantilever structure where the same atomic force microscope observation as usual can be performed, The point that provide to a module with the two same probe scanning points, and they are realized in the almost same location is the description common to the gestalt of other the operation of each, and can all do the same operation effectiveness so.
[0069] Moreover, it sets to **** and is Si O2 as Si Ox. Although explained per [which was adopted] mode, of course, other silicon system matter is applicable.
[0070] In addition, although various means were restrictively explained in the gestalt of the above-mentioned implementation, it is also possible to change suitably in the range which this contractor can design.
[0071]
[Effect of the Invention] As mentioned above, as explained in full detail, according to invention of claim 1, the optical transmission layer with which it reached on the other hand by the metal membrane which has a light reflex property, and the interface of another side was covered leads the introduced light to a probe section point efficiently as optical waveguide, and the I/O of light of it is attained [near the probe section tip].
[0072] According to invention of claim 2, moreover, the optical transmission layer which extends along with one principal plane of the cantilever section and the probe section Since it reaches on the other hand, the interface of another side is covered with the metal membrane which has a light reflex property and external exposure of the optical transmission layer is moreover carried out [near the tip of the probe section] By the optical waveguide formed in the form by which the laminating was carried out to the probe section side, an introductory light is efficiently led to a probe section point, and I/O of light is attained [near the probe section tip].
[0073] According to invention of claim 3, the optical waveguide formed of the metal membrane which has the light reflex property which covers the cantilever section and the probe section except for the apical surface of the probe section, and the cantilever and the probe section which have an optical transmission property, respectively leads an introductory light to a probe section point efficiently through the cantilever section concerned and the probe section, and enables I/O of light [near the probe section tip].
[0074] Furthermore, the 1st metal membrane which has the light reflex property which covers the probe section according to invention of claim 4, The optical transmission layer by which the laminating was carried out to the 1st metal membrane, and the 2nd metal membrane which has the light reflex property which covers an optical transmission layer and the cantilever section, carrying out external exposure of the optical transmission layer [near the tip of the probe section], By the cantilever section which has an optical transmission property, optical waveguide is formed, an introductory light is efficiently led to a probe section point through the cantilever section, and I/O of light is enabled [near the probe section tip]. Furthermore, the 1st metal membrane becomes possible [functioning as an electrode for the potential measurement on the front face of a sample], light is irradiated at a sample, it is in the condition which excited the sample front face, and it also becomes possible to carry out potential measurement to coincidence.
[0075] Moreover, according to invention of claim 5, the above-mentioned optical waveguide which

draws light near the probe section applies a semi-conductor manufacture process in accordance with the radicalized probe configuration, and may be formed.
[0076] In this way, according to this invention, homogeneity of minute opening for approaching space optical measurement formed is made good, and also when it moreover uses for atomic force microscope observation etc., the probe and its manufacture approach of the scanning probe microscope which can obtain high resolving power can be offered.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the flat surface of the scanning probe by the gestalt 1 of operation of this invention, and the outline of longitudinal cross-section structure.
[Drawing 2] It is drawing showing the flat surface of the scanning probe by the gestalt 2 of operation of this invention, and the outline of longitudinal cross-section structure.
[Drawing 3] It is drawing showing the flat surface of the scanning probe by the gestalt 3 of operation of this invention, and the outline of longitudinal cross-section structure.
[Drawing 4] It is drawing showing the tooth back of the scanning probe by the gestalt 4 of operation of this invention, and the outline of longitudinal cross-section structure.
[Drawing 5] It is the perspective view of the probe of drawing 4 .
[Drawing 6] It is the schematic diagram showing the configuration which formed two or more scanning probes by the gestalt of operation of this invention in one susceptor.
[Drawing 7] It is the sectional view of the probe concerned for explaining the first four processes among production processes with the main probe of drawing 1 .
[Drawing 8] It is the sectional view of the probe concerned for explaining the following four processes among production processes with the main probe of drawing 1 .
[Drawing 9] It is the sectional view of the probe concerned for explaining four processes which continue further among production processes with the main probe of drawing 1 .
[Drawing 10] It is the sectional view of the probe concerned for explaining the last four processes among production processes with the main probe of drawing 1 .
[Drawing 11] It is the perspective view showing the structure of the probe by the conventional example.
[Description of Notations]
10 Cantilever Section
11 Probe
12 Fixed-End Section
1e Probe point
20 Susceptor
30 Optical Transmission Layer (Film)
40 Metal Thin Film
41 1st Metal Thin Film
42 2nd Metal Thin Film
31 Tooth-Back Optical Transmission Layer
32 Probe Section Extension Optical Transmission Layer
1 Silicon Substrate
1M Silicon oxide
1M0 Mask
1R Photoresist
One R0 Resist mask

110 Silicon Projection
1X Silicon oxide
401,402 Metal thin film
4R, 4R' Resist
402' Exposure covering ****
30' Exposure optical transmission ****

[Translation done.]

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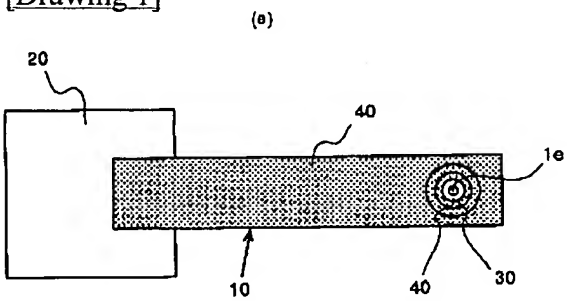
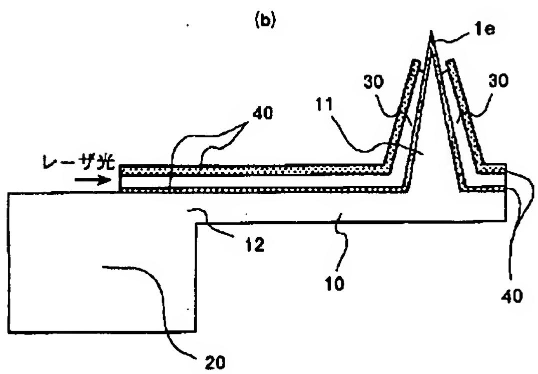
DRAWINGS

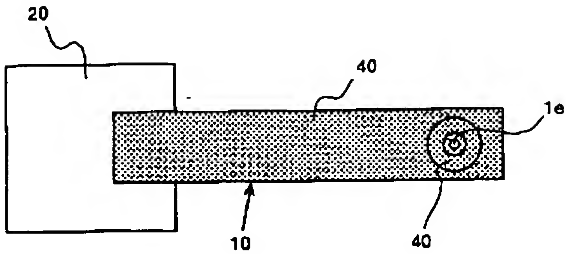
[Drawing 1]





[Drawing 2]

(a)



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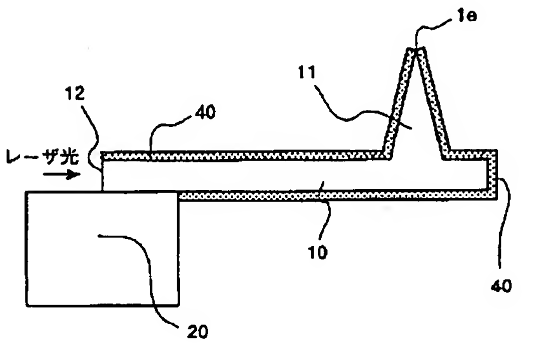
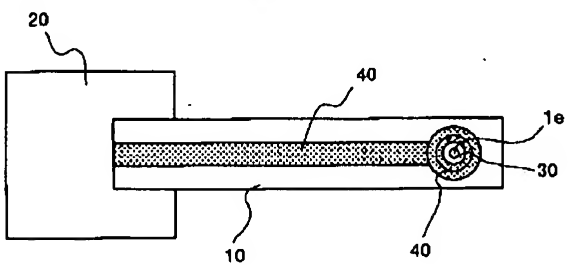


[Drawing 3]

(a)



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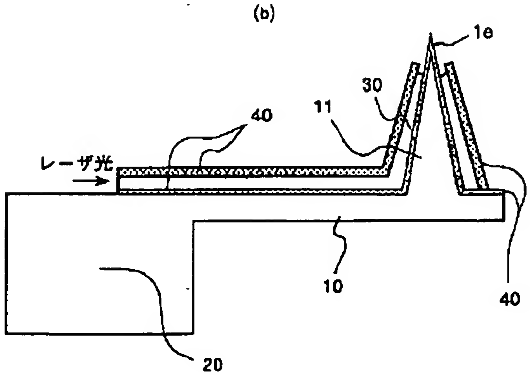
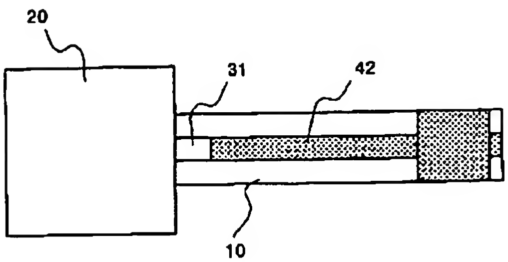


[Drawing 4]

(a)



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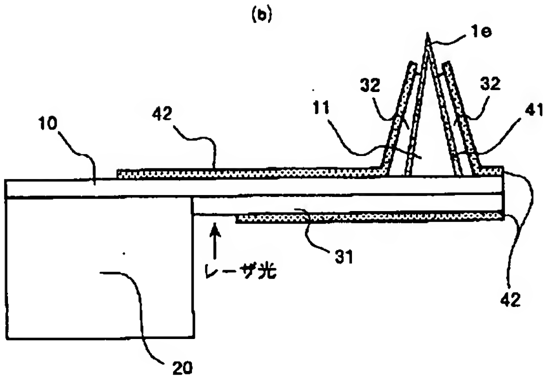

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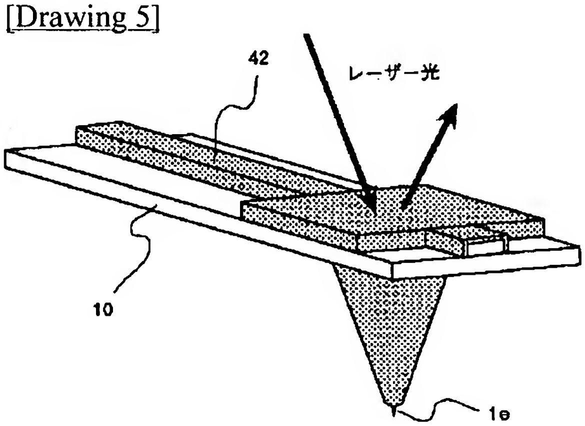
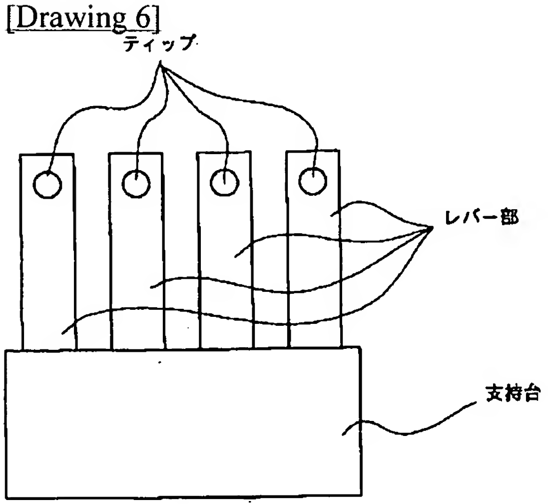


[Drawing 6]



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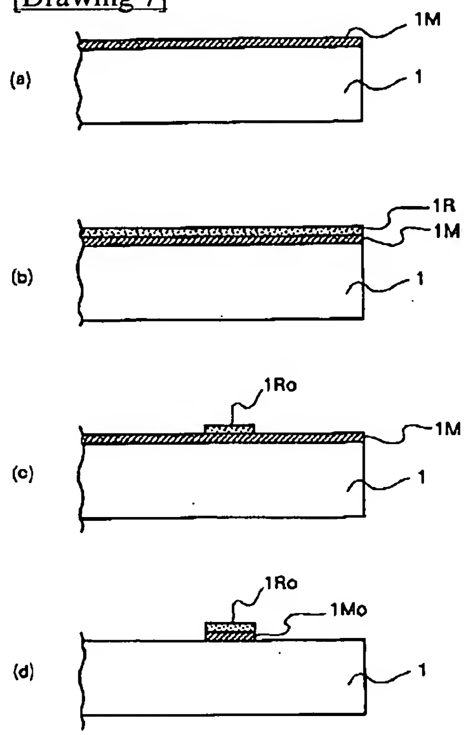

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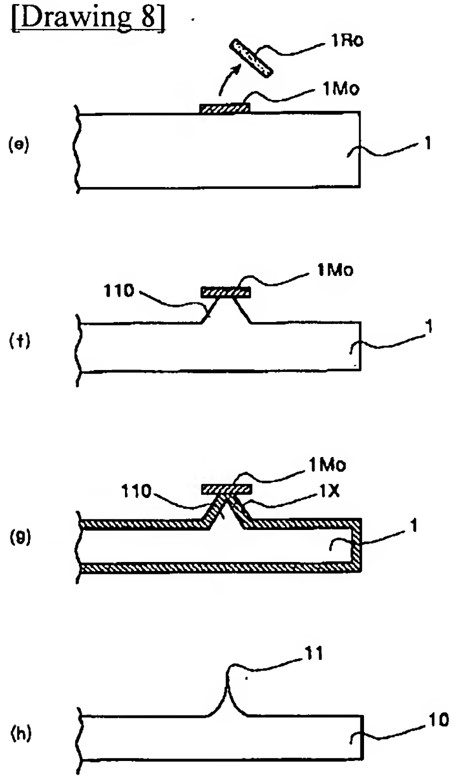

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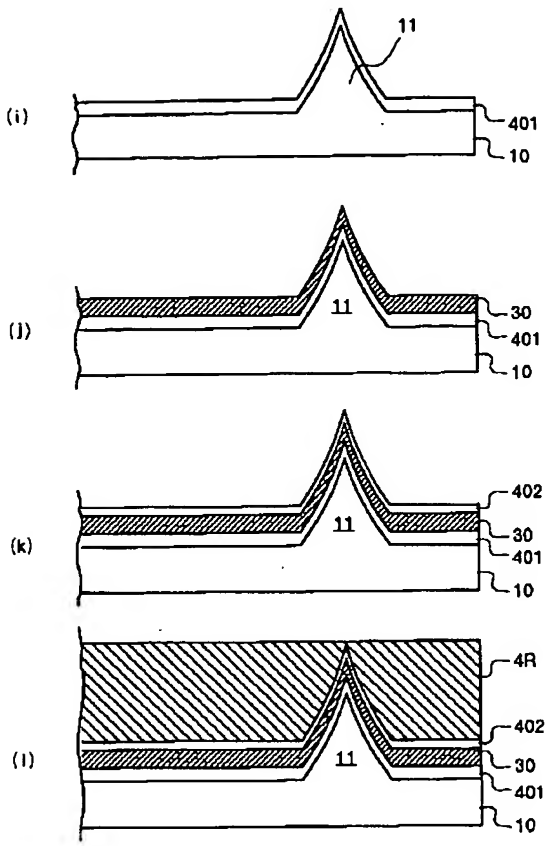
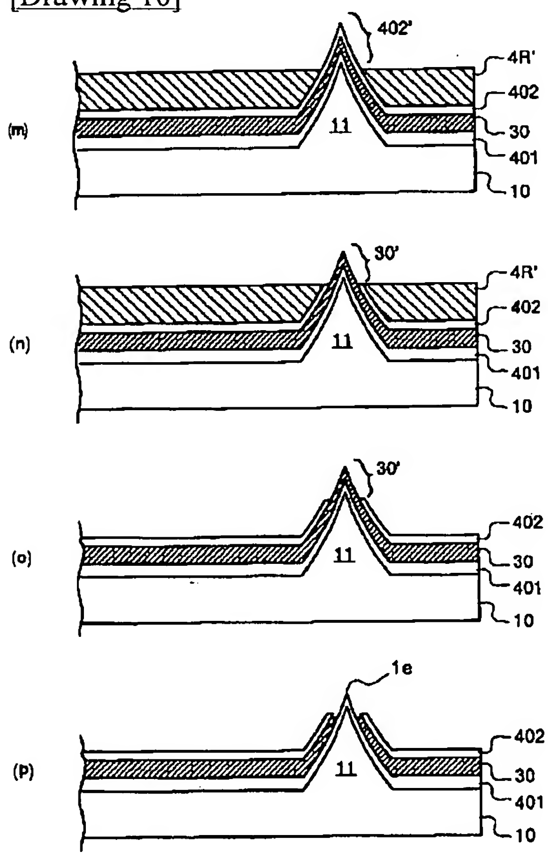


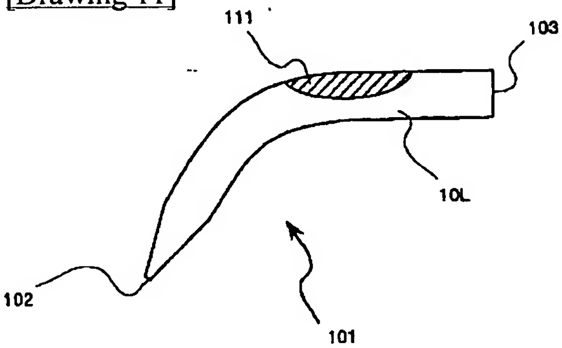
11
(i)
401
10
(j)
30
401
10
(k)
402
30
401
10
(l)
4R
402
30
401
10

[Drawing 10]



(m)
402'
4R'
402
30
401
10
(n)
30'
4R'
402
30
401
10
(o)
30'
402
30
401
10
(p)
1e
402
30
401
10

[Drawing 11]



[Translation done.]